City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 4: WASTEWATER TREATMENT SYSTEM
CHAPTER 6: PRIMARY TREATMENT

FINAL
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City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

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PRIMARY TREATMENT

6.1 PURPOSE

The purpose of this chapter is to evaluate the configuration alternatives for new primary clarifiers that will meet the expansion needs at the Regional Water Quality Control Plant (RWQCP).

6.2 CONCLUSIONS AND RECOMMENDATIONS

- The existing Plant 2 primary clarifiers have a capacity of 20 mgd on an annual average flow basis. New primary clarifiers will have an annual average flow capacity of 32 mgd and replace the existing Plant 1A and Plant 1B primary clarifiers.
- Rectangular and circular alternatives are compared. The life-cycle costs for the two alternatives are similar. Circular primaries will be used, given that the costs are similar, circular clarifiers are easier to maintain, and circular units will fit on the site.
- The type of primary sludge pumps will be decided during preliminary design based on flow quantity and pumping head.
- The abandoned Plant 1 secondary sedimentation basins and chlorine contact basin will be demolished and may be the location of a future primary effluent equalization basin.
- Biofilters will be used for odor control for the primary clarifiers (new Plant 1 and existing Plant 2) and for the new headworks facilities. The primary clarifiers will be covered with low profile aluminum domes for odor control. The biofilter is estimated to be 150 feet by 200 feet. The biofilter will be located at the existing Plant 1A primary clarifiers. Therefore, it will be built after the new clarifiers are put in service and the Plant 1A clarifiers are demolished.

6.3 BACKGROUND

It was decided at the project meeting on July 13, 2006 that the Plant 1 primaries would be replaced, because both Plant 1A and Plant 1B primaries were built in the 1950s and no longer consistently provide effective treatment. Primary facilities of the new Plant 1 and the existing Plant 2 will have a combined capacity of 52 mgd annual average daily flow, according to the flow projection for the year 2025. The Plant 2 primaries have a capacity of 20 mgd, so the new Plant 1 primaries will have a capacity of 32 mgd.

6.4 EXISTING PRIMARY TREATMENT FACILITIES

The existing primary treatment facilities are listed in Table 6.1. As discussed in Volume 4, Chapter 1 - Existing Facilities, the primary sedimentation facilities at Plant 1 were originally designed to pump the settled solids into gravity thickeners. However, currently, the settled solids from the Plant 1 primaries are pumped into the primary influent splitter box for Plant 2 and are resettled with the Plant 2 influent solids. The Plant 2 primary sludge is thickened in the primaries and is pumped directly to the anaerobic digesters. Ferric sulfate is added to the Plant 1 primaries to keep the RWQCP hydrogen sulfide levels within the South Coast Air Quality Management District (SCAQMD) limits.

Table 6.1 Existing Primary Treatment Facilities
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Description		Value
Primary Sedimentation		
Plant 1		
Basins - Rectangular	Plant 1A	Plant 1B
Number	4	2
Length, feet	104	163.5
Width, feet	26	37
Units in Operation	All	All
Total Volume, gallons	688,700	768,900
Total Surface Area, feet^2	10,816	12,100
Sludge Pumps - Non-Clog Centrifugal	Plant 1A	Plant 1B
Number	3	2
Size, gpm/each	450	450
Plant 2		
Basins - Circular		
Number of Basins		4
Diameter, feet		95
Units in Operation		All
Total Volume, gallons		2,004,000
Total Surface Area, feet^2		28,350
Sludge Pumps - Progressive Cavity		
Number		6
Size, gpm/each		100
Ferric Sulfate		
Number of Tanks		1
Volume, gallons		6,000
Usage, gpm		700 to 1200

6.5 DESIGN CRITERIA

The Surface Overflow Rate (SOR) used to size the new primary sedimentation tanks is up to 1,200 gpd/ft^2 and 2,250 gpd/ft^2 at average and wet weather peak flow rates, respectively. The annual average and wet weather peak flow rates for the primaries will be 32 mgd and 70 mgd, respectively.

To size the biofilters, a foul air exchange rate of 12 changes per hour, and a load for the biofilters of no more than 3 scfm/ft^2 is used.

6.6 NEW PRIMARY CLARIFIER EVALUATION

Both circular and rectangular configurations are commonly used for primary clarifier basins at wastewater treatment plants. For the RQWCP, both configurations are evaluated based on a life cycle cost analysis as well as other non-economic factors.

6.6.1 Alternative 1 - Rectangular Primary Clarifiers

Figure 6.1 shows the layout of Alternative 1 – Rectangular Primary Clarifiers. There would be six (five duty and one standby) rectangular tanks, each with a width of 40 feet and a length of 160 feet. The outside dimension is estimated to be 260 feet by 210 feet including the pumps and splitting channel west of the channels.

Because of the existing Plant 1B primary effluent pipe, Alternative 1 would be constructed in two phases. The existing Plant 1B primaries would need to stay in service until Phase 1 of the new primaries was constructed. Approximately 30 feet of clearance would be provided between the new and existing structures. The rectangular tanks would be covered with aluminum covers.

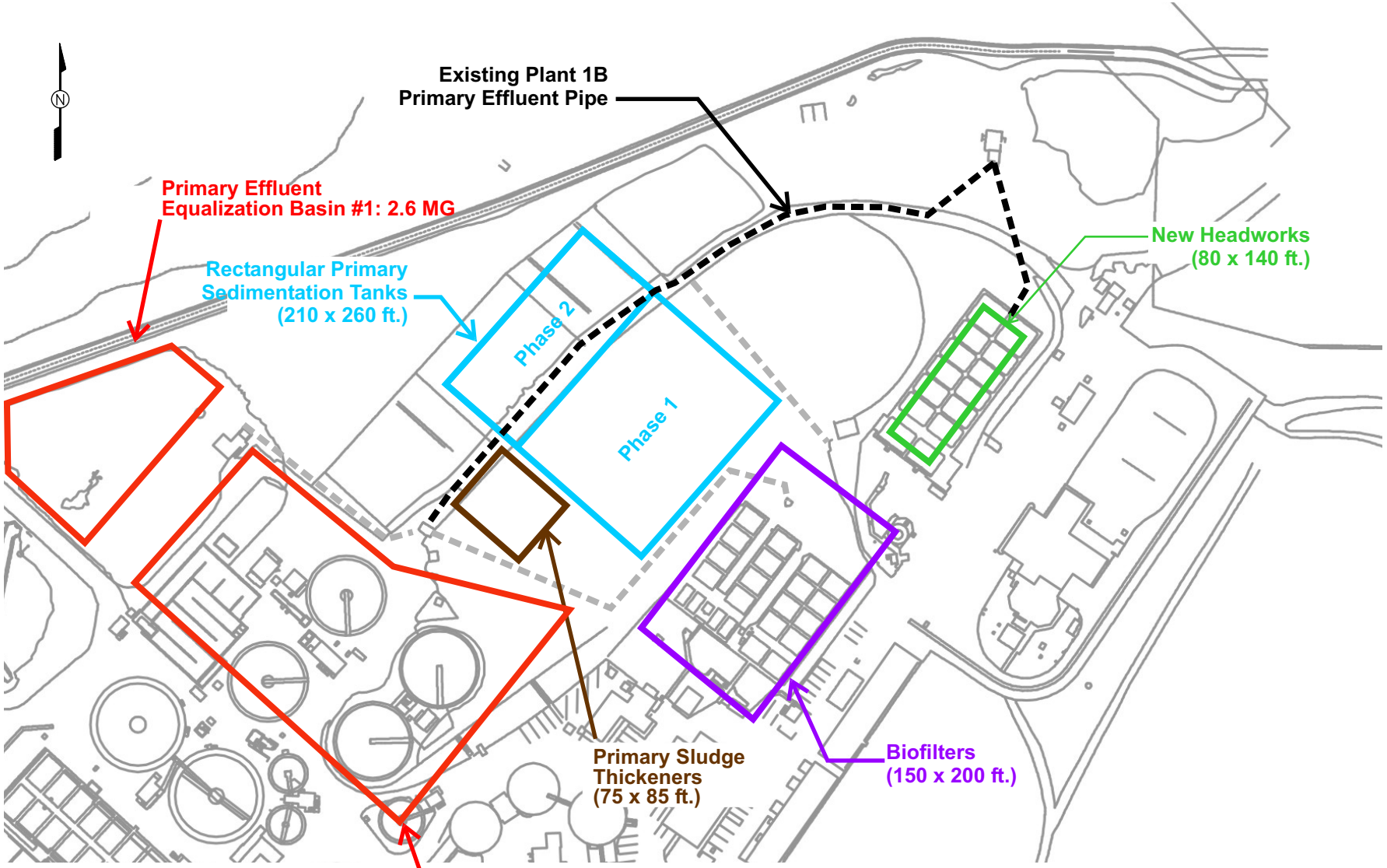
The rectangular clarifier chain and flight collection mechanism would be constructed of non-metallic material and would likely need replacement after approximately 10 to 15 years, assuming normal use and wear.

6.6.2 Alternative 2 - Circular Primary Clarifiers

Figure 6.2 shows the layout of Alternative 2 – Circular Primary Clarifiers. There would be four (three duty and one standby) circular clarifiers, each with a diameter of 120 feet. Two of the clarifiers would be located in the area of the abandoned sludge beds, which are currently used for debris storage.

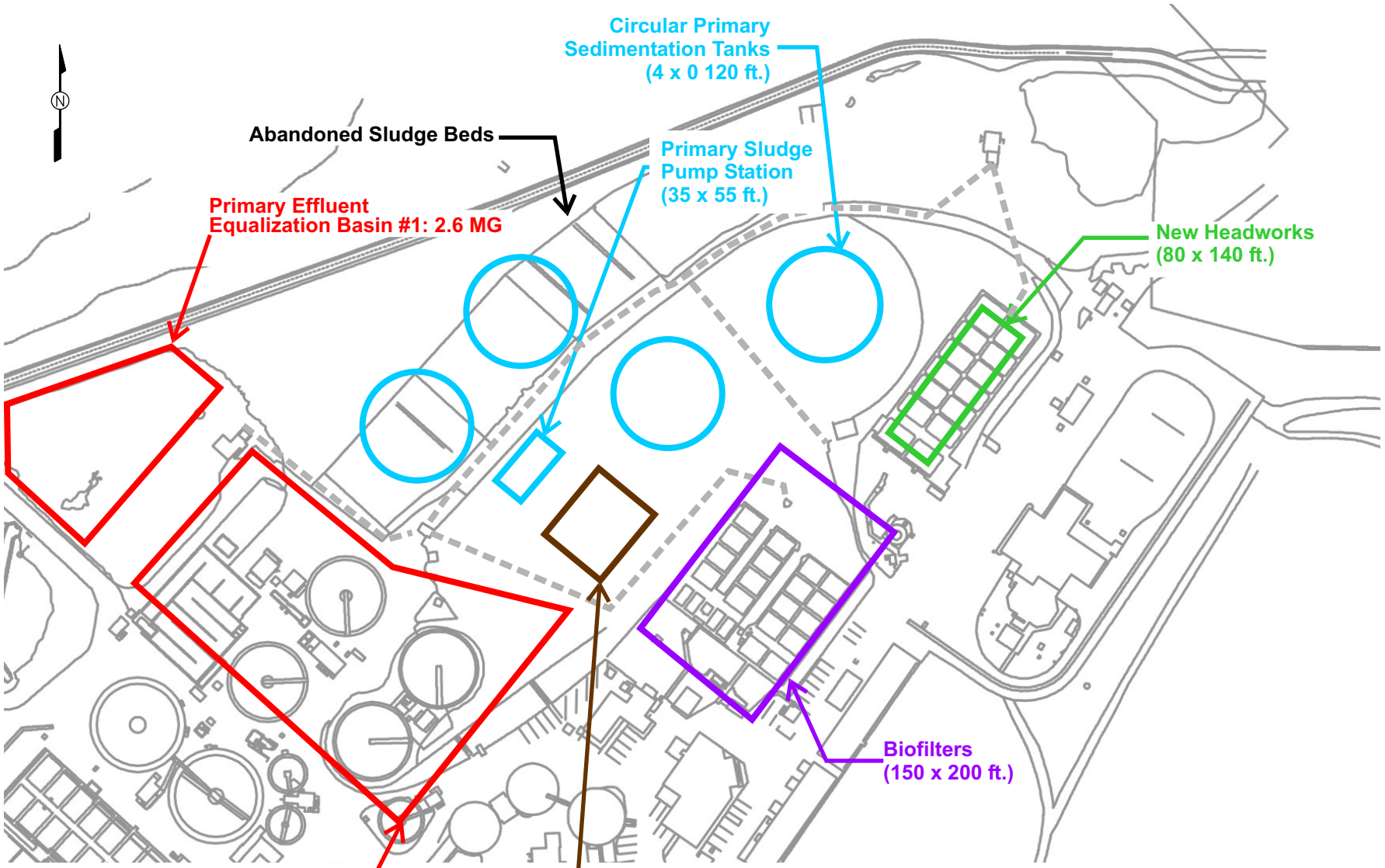
Circular clarifiers usually result in a higher headloss when compared to rectangular clarifiers, but there is adequate head available for circular clarifiers.

In general, circular clarifier sludge collection mechanisms are simpler to construct and are easier to maintain as compared to rectangular clarifier chain and flight mechanisms. Each link (and sprocket) in a chain and flight mechanism is a moving part and subject to wear,



NEW PRIMARY TREATMENT FACILITIES LAYOUT: PLANT 1 ALTERNATIVE 1

FIGURE 6.1



NEW PRIMARY TREATMENT FACILITIES LAYOUT: PLANT 1 ALTERNATIVE 2

FIGURE 6.2

whereas a circular collection mechanism has a single main rotating turntable that is located at the deck level above the water surface.

Circular primary clarifiers are more suited for in-tank-thickening. At the project meeting on September 20, 2006, it was decided that clarifiers will not be used to thicken the sludge.

6.7 COMPARISON AND LIFE-CYCLE COST OF ALTERNATIVES

A comparison of the two alternatives is presented in Table 6.2. Life-cycle costs for the two alternatives are shown in Table 6.3.

Table 6.2 Comparison of Rectangular and Circular Primary Clarifiers Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside

	Alternative 1 Rectangular	Alternative 2 Circular
Average SOR (gpd/ft^2)	1,000	943
Maximum SOR (gpd/ft^2)	2,200	2,075
Quantity	6 (5 duty/1 standby)	4 (3 duty/1 standby)
Dimension	160-foot L by 40-foot W by 12-foot SWD	120-foot diameter by 12-foot SWD
Simplicity of Mechanism	–	+
Maintenance Requirement	–	+
Separate Flow Splitting Structure	+	–
Separate Sludge Pumping Station	+	–
Space Requirement	+	–
Construction Staging Requirement	–	+
Capital Cost	+	–
Maintenance Cost	–	+
Potential for In-Tank-Thickening	–	+

Ratings:
+ = Positive comparative characteristic.
– = Negative comparative characteristic.
0 = Neutral comparative characteristic.

Table 6.3	Life-Cycle Cost of Rectangular and Circular Primary Clarifiers Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside	
	Alternative 1 - Rectangular	**Alternative 2 - Circular**
Direct Costs(1)	$7,570,000	$8,600,000
Total Project Cost(1)	$24,000,000	$27,200,000
Yearly Maintenance Cost	$12,000	$8,000
Mechanism Replacement Cost	$1,400,000(2)	$0
Total Life Cycle Cost(3)	**$25,500,000**	**$27,400,000**

Notes:
(1) Including primary clarifiers, influent splitter box, and primary sludge pump station.
(2) Replacement for chain and flight sludge collector every 10 years.
(3) As present value, assuming life-cycle period of 19 years, discount rate of 6 percent, and escalation rate of 6 percent for the first 5 years and 4 percent thereafter.

The total project capital cost of Alternative 1 is slightly lower because of the common wall construction for rectangular clarifiers. The total life-cycle costs for the two alternatives are similar.

It was decided at the October 18, 2006 project meeting to use circular clarifiers, because the life-cycle costs are similar and they are easier to maintain than rectangular clarifiers.

6.8 PRIMARY SLUDGE PUMPING

The type of primary sludge pumps will be one of the following, depending on the final design criteria for the flow quantity and pumping head required.

- Non-clog centrifugal.
- Screw centrifugal.
- Progressing cavity.

The final decision will be made during preliminary design.

6.9 ODOR CONTROL

There are several options available for odor scrubbing. However on a life cycle cost basis, if sufficient land is available, biofilters are the best option. Since sufficient land is available at the RWQCP, it was decided at the project meeting on September 20, 2006 that biofilters would be used for odor scrubbing.

The biofilters will be built after the completion of the new primary clarifiers, when Plant 1A can be demolished for the space.

The foul air to be treated in the new biofilters comes from the new headworks, the new Plant 1 primaries, and the existing Plant 2 primaries. The dimension is estimated to be 150 feet by 200 feet, and the total project cost is estimated to be $16.7 million.